

[0021] Another object is to provide a power supply system where galvanic insulation is present between the first and second AC terminals in a cost efficient way.

[0022] Another object is that the present invention should be usable in many types of applications, including applications where renewable energy may be produced periodically.

#### SUMMARY OF THE INVENTION

[0023] The invention has been set forth in the claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Embodiments of the invention will now be described in detail with reference to the enclosed drawings, where:

[0025] FIG. 1 is a perspective schematic view illustrating a power supply system provided within a cabinet;

[0026] FIG. 2 is a schematic block diagram illustrating an electric multi-mode power converter module;

[0027] FIG. 3 is a schematic view illustrating a rear side of an electric multi-mode power converter module and its module connectors;

[0028] FIG. 4 is a schematic view illustrating two electric multi-mode power converter modules and their connection to first and second printed circuit boards;

[0029] FIG. 5-9 illustrates the power flow through the module in different states and under different conditions.

#### DETAILED DESCRIPTION

[0030] FIG. 1 illustrates a power supply system 1 provided in a cabinet 2. In an upper part of the cabinet 2 shelves 20 are provided. In this example there are six shelves, one above another. For example, each shelf may have a standardized width of 19 inches and height of 1 U (rack unit).

[0031] The power supply system 1 includes a number of converter modules 10. In the illustrated example, each shelf 20 comprises four compartments, one compartment for each converter module 10. Also a control module 5 is provided in the upper part of the cabinet 2.

[0032] A “module” is here is one piece or unit of equipment which may be inserted into or taken out from the above compartments. The module comprises electrical and electronic components connected to a printed circuit board which are fitted into a chassis, typically with all its connection interfaces available on its rear side. In addition, the module often comprises a fan for blowing air through the chassis in order to remove heat participated by the components.

[0033] In the lower part 6 of the cabinet 2, batteries are provided.

[0034] All connection interfaces of the converter modules are located on the rear side of the converter modules 10, and the connectors for connection of the converter module 10 to the input AC power, the output DC power, the control module 5, etc., are located on the rear side of the shelves. Hence, it is possible to connect the converter module 10 to the shelf by pushing the converter module into the correct position of the shelf.

[0035] In power supply systems of related prior art, it was required that the cabinet 2 was configured correctly. Some prior art power supply systems had two or more different types of converter modules. It was then important that the correct type of converter module was placed into its correct position in the correct shelf.

[0036] In an aspect of the present invention, the power supply system 1 includes a number of electric multi-mode power converter 10 module of the type disclosed herein.

[0037] FIG. 2 is a schematic block diagram illustrating an electric multi-mode power converter module 10 according to the invention.

[0038] The electric multi-mode power converter module 10 comprises an AC/DC converter 30 which includes a first AC port 32. The electric multi-mode power converter module 10 further comprises a DC/AC converter 40 which includes a second AC port 42. Also, the electric multi-mode power converter module 10 comprises a DC/DC converter 50 which includes a DC port 52.

[0039] Each of the AC/DC converter 30, DC/AC converter 40 and DC/DC converter 50 may be of any suitable type, which may be selected by the skilled person. Each converter is controllable by means of external control communication means, such as a communication bus 70.

[0040] The electric multi-mode power converter module 10 further comprises a controller 60 and the communication bus 70 which interconnects the AC/DC converter 30, the DC/AC converter 40, the DC/DC converter 50, and the controller 60. Hence, the purpose of the communication bus 70 is to provide communication between the controller and the respective controllers 30, 40, 50.

[0041] The electric multi-mode power converter module 10 further comprises an internal DC bus 72 for transferring electric power between the AC/DC converter 30, the DC/AC converter 40 and the DC/DC converter 50. This internal DC bus 72 is indicated by the bi-directional arrows in FIG. 2.

[0042] The electric and electronic components of the AC/DC converter 30, the DC/AC converter 40 and the DC/DC converter 50 and the control of these circuits are described in detail in WO 2014/114481, WO 2012/055869 and WO2012/055862. It should be noted that also other topologies and methods to control them can be used in a module and a power supply system described herein.

[0043] The controller may include a microcontroller or microprocessor and a memory for holding processing instructions which causes the controller to perform certain control/configuration tasks in dependence of a predetermined operating state, which will be explained further below. Alternatively, the controller may include other type of logic circuits, e.g. programmable logic circuits, etc., which enable its functionality as disclosed herein.

[0044] The controller 60 also includes a hardware configuration port 62. The controller 60 is configured to read a value from the hardware configuration port 62.

[0045] The controller 60 is configured to set the power converter module 10 in one operating state, which is selected among a predetermined set of states. The selection of the predetermined set of states is made by the controller 60 in dependency of the value read from the hardware configuration port 62. The set of predetermined states include the following:

[0046] a first state in which the power converter module 10 transfers power between the first AC port 32 and the DC port 52, and in which the second AC port 42 is disabled,

[0047] a second state in which the power converter module 10 transfers power between the DC port 52 and the second AC port 42, and the first AC port 32 is disabled, and